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IMAGE PREDICTIVE CODING METHOD

VERIFICATION OF ENGLISH TRANSLATION

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Sir:

I, Kazuhiko YASUI of c/o Aoyama & Partners, IMP Building, 1-3-7, Shiromi, Chuo-ku, Osaka 540-0001 Japan, declare that I am conversant in both the Japanese and English languages and that the English translation as attached hereto is an accurate translation of Japanese Patent Application No. P8-132970 filed on May 28, 1996.

February 12, 2008

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Title of the Invention:

METHOD AND APPARATUS FOR INTRA-FRAME PREDICTIVE CODING AND DECODING

Claims:

1. An image predictive coding apparatus characterized in that,

in a process of receiving an image to be coded, dividing the image to be coded into a plurality of adjacent small regions and coding a target small region among the plurality of adjacent small regions,

said apparatus performs the following steps of: using reproduced pixel values adjacent to the target small region as pixel values of an intra-frame prediction small region of the target small region; using the intra-frame prediction small region as an optimum prediction small region; generating a difference small region from the target small region and the optimum prediction small region; coding the difference small region; after these steps, decoding the coded difference small region, adding the decoded difference small region to the optimum prediction small region, and generating and storing a reproduced small region.

2. The image predictive coding apparatus as claimed in Claim 1,

wherein vertically adjacent reproduced pixel values are used as the pixel values of the intra-frame prediction small region.

3. The image predictive coding apparatus as claimed in Claim 1,

wherein horizontally adjacent reproduced pixel values are used as pixel values of the intra-frame prediction small region.

4. The image predictive coding apparatus as claimed in Claim 1,

wherein vertically adjacent reproduced pixel values are used as pixel values of a first intermediate small region, horizontally adjacent reproduced pixel values are used as pixel values of a second intermediate small region, and the pixel values of the first intermediate small region and the pixel values of the second intermediate small region are weighted and averaged so as to be used as the pixel values of the intra-frame prediction small region.

5. The image predictive coding apparatus as claimed in Claim 1,

wherein vertically adjacent reproduced pixel values are used as pixel values of a first intermediate small region, horizontally adjacent reproduced pixel values are used as pixel values of a second intermediate small

region, the pixel values of the first intermediate small region and the pixel values of the second intermediate small region are weighted and averaged so as to be used as pixel values of a third intermediate small region, and pixel values of one of the first, second and third intermediate small regions are used as the pixel values of the intra-frame prediction small region.

6. The image predictive coding apparatus as claimed in Claim 1,

wherein one of the first, second and third intermediate small regions, whichever it has the smallest error with respect to the target small region, is used as the intra-frame prediction small region, an identifier for identifying the first, second and third intermediate small regions is added to the intra-frame prediction small region, and the coding process is performed.

7. The image predictive coding apparatus as claimed in any one of Claims 1 to 5, further performing a step of generating a time prediction small region from at least one reference image which has been coded and reproduced previously in time in addition to the intra-frame prediction small region,

wherein pixel value of one of the intra-frame prediction small region and the time prediction small region are used as the pixel value of the optimum

prediction small region.

8. The image predictive coding apparatus as claimed in Claim 7,

wherein an identifier for identifying the intra-frame prediction small region and the time prediction small region is added and the coding process is performed.

9. An image predictive coding apparatus characterized in that,

in a process of receiving an image to be coded and a significant signal showing whether or not a pixel value of the image to be coded is significant, dividing the image to be coded into a plurality of adjacent small regions and coding a target small region among the plurality of adjacent small regions,

said apparatus performs the following steps of: using only significant pixel values among the reproduced pixel values adjacent to the target small region as pixel values of an intra-frame prediction small region of the target small region; using the intra-frame prediction small region as an optimum prediction small region; generating a difference small region from the target small region and the optimum prediction small region; coding the difference small region; after these steps, decoding the coded difference small region, adding the decoded difference small region to the optimum prediction small region, and

generating and storing a reproduced small region.

10. The image predictive coding apparatus as claimed in Claim 9,

wherein only significant pixel values among vertically adjacent reproduced pixel values are used as the pixel values of the intra-frame prediction small region.

11. The image predictive coding apparatus as claimed in Claim 9,

wherein only significant pixel values among horizontally adjacent reproduced pixel values are used as the pixel values of the intra-frame prediction small region.

12. The image predictive coding apparatus as claimed in Claim 9,

wherein only significant pixel values among vertically adjacent reproduced pixel values are used as pixel values of a first intermediate small region, only significant pixel values among horizontally adjacent reproduced pixel values are used as pixel values of a second intermediate small region, and the pixel values of the first intermediate small region and the pixel values of the second intermediate small region are weighted and averaged so as to be used as the pixel values of the intra-frame prediction small region.

13. The image predictive coding apparatus as

claimed in Claim 9,

wherein only significant pixel values among vertically adjacent reproduced pixel values are used as pixel values of a first intermediate small region, only significant pixel values among horizontally adjacent reproduced pixel values are used as pixel values of a second intermediate small region, the pixel values of the first intermediate small region and the pixel values of the second intermediate small region are weighted and averaged so as to be used as pixel values of a third intermediate small region, and the pixel values of one of the first, second and third intermediate small regions are used as the intra-frame prediction small region.

14. The image predictive coding apparatus as claimed in Claim 9,

wherein an average value of only significant pixel values among the reproduced pixel values adjacent to the target small region is used as a pixel value of the intra-frame prediction small region.

15. The image predictive coding apparatus as claimed in any one of Claims 9 to 14,

further performing a step of generating a time prediction small region from at least one reference image which has been coded and reproduced previously in time in addition to the intra-frame prediction small region,

wherein pixel value of one of the intra-frame prediction small region and the time prediction small region are used as the pixel value of the optimum prediction small region.

16. An image predictive decoding apparatus comprising:

an input terminal, a data analyzer, a decoder, an adder, a prediction signal generator and a line memory,

wherein said image predictive coding apparatus performs the following steps of:

receiving an input of a coded image data series through the input terminal;

analyzing the coded image data series and outputting an image difference signal by the data analyzer;

inputting the difference image signal to the decoder and restoring it to a reproduction difference small region;

inputting pixel values to the prediction signal generator from the line memory, using reproduced pixel values adjacent to the reproduction difference small region as pixel values of an intra-frame prediction small region, and outputting the intra-frame prediction small region as an optimum prediction small region; and

adding the reproduction difference small region to the optimum prediction small region by the adder,

outputting an image and storing only pixel values for generating the intra-frame prediction small region into the line memory.

17. An image predictive decoding apparatus as claimed in Claim 16,

wherein vertically adjacent reproduced pixel values are used as pixel values of a first intermediate small region, horizontally adjacent reproduced pixel values are used as pixel values of a second intermediate small region, the pixel values of the first intermediate small region and the pixel values of the second intermediate small region are weighted and averaged so as to be used as pixel values of a third intermediate small region, and pixel values of one of the first, second and third intermediate small regions are used as the pixel values of the intra-frame prediction small region.

18. An image predictive decoding apparatus comprising:

an input terminal, a data analyzer, a decoder, an adder, a prediction signal generator, a line memory, a motion compensator, a frame memory and a controller,

wherein said image predictive coding apparatus performs the following steps of:

receiving an input of a coded image data series through the input terminal;

analyzing the coded image data series and outputting an image difference signal, a motion vector signal and a control signal by the data analyzer;

inputting the difference image signal to the decoder and restoring it to a reproduction difference small region;

inputting the control signal to the controller and outputting a switching signal for controlling the motion compensator and the prediction signal generator;

when the motion compensator is operated by the switching signal, inputting the motion vector signal to the motion compensator, acquiring a time prediction small region from the frame memory and outputting an optimum prediction small region;

when the prediction signal generator is operated by the switching signal, inputting pixel values from the line memory to the prediction signal generator, using reproduced pixel values adjacent to the reproduction difference small region as pixel values of an intra-frame prediction small region and outputting the intra-frame prediction small region as an optimum prediction small region; and

adding the reproduction difference small region to the optimum prediction small region to thereby output reproduction image and simultaneously storing the

reproduction image into the frame memory, and storing only pixel values for generating the intra-frame prediction small region into the line memory.

19. The image predictive decoding apparatus as claimed in Claim 18,

wherein vertically adjacent reproduced pixel values are used as pixel values of a first intermediate small region, horizontally adjacent reproduced pixel values are used as pixel values of a second intermediate small region, the pixel values of the first intermediate small region and the pixel values of the second intermediate small region are weighted and averaged so as to be used as pixel values of a third intermediate small region, and pixel values of one of the first, second and third intermediate small regions are used as the pixel values of the intra-frame prediction small region according to the switching signal.

20. An image predictive decoding apparatus comprising:

an input terminal, a data analyzer, a first decoder, a second decoder, an adder, a prediction signal generator and a line memory,

wherein said image predictive coding apparatus performs the following steps of:

receiving an input of a coded image data series

through the input terminal;

analyzing the coded image data series and outputting a compressed shape signal and an image difference signal by the data analyzer;

inputting the compressed shape signal to the first decoder and restoring it to a reproduction shape signal;

inputting the difference image signal to the second decoder and restoring it to a reproduction difference small region;

inputting pixel values to the prediction signal generator from the line memory, using only significant pixel values shown by the reproduction shape signal among the reproduced pixel values adjacent to the reproduction difference small region as pixel values of an intra-frame prediction small region, and outputting the intra-frame prediction small region as an optimum prediction small region; and

adding the reproduction difference small region to the optimum prediction small region by the adder, outputting an image and storing only pixel values for generating the intra-frame prediction small region into the line memory.

21. The image predictive decoding apparatus as claimed in Claim 20,

wherein only significant pixel values shown by a reproduction shape signal among vertically adjacent reproduced pixel values are used as pixel values of a first intermediate small region, only significant pixel values shown by the reproduction shape signal among horizontally adjacent reproduced pixel values are used as pixel values of a second intermediate small region, the pixel values of the first intermediate small region and the pixel values of the second intermediate small region are weighted and averaged so as to be used as pixel values of a third intermediate small region, and the pixel values of one of the first, second and third intermediate small regions are used as pixel values of the intra-frame prediction small region.

22. An image predictive decoding apparatus comprising:

an input terminal, a data analyzer, a first decoder, a second decoder, an adder, a prediction signal generator, a line memory, a motion compensator, a frame memory and a controller,

wherein said image predictive coding apparatus performs the following steps of:

receiving an input of a coded image data series through the input terminal;

analyzing the image data series and outputting a

compressed shape signal, an image difference signal, a motion vector signal and a control signal by the data analyzer;

inputting the compressed shape signal to the first decoder and restoring it to a reproduction shape signal;

inputting the difference image signal to the second decoder and restoring it to a reproduction difference small region;

inputting the control signal to the controller and outputting a switching signal for controlling the motion compensator and the prediction signal generator;

when the motion compensator is operated by the switching signal, inputting the motion vector signal to the motion compensator, acquiring a time prediction small region from the frame memory according to the motion vector signal and outputting an optimum prediction small region;

when the prediction signal generator is operated by the switching signal, inputting pixel values from the line memory to the prediction signal generator, using only significant pixel values shown by the reproduction shape signal among reproduced pixel values adjacent to the reproduction difference small region as pixel values of an intra-frame prediction small region and outputting the intra-frame prediction small region as an optimum

prediction small region; and

adding the reproduction difference small region to the optimum prediction small region to thereby output a reproduction image and simultaneously storing the reproduction image into the frame memory, and storing only pixel values for generating the intra-frame prediction small region into the line memory.

23. The image predictive decoding apparatus as claimed in Claim 21,

wherein only significant pixel values shown by a reproduction shape signal among vertically adjacent reproduced pixel values are used as pixel values of a first intermediate small region, only significant pixel values shown by the reproduction shape signal among horizontally adjacent reproduced pixel values are used as pixel values of a second intermediate small region, the pixel values of the first intermediate small region and the pixel values of the second intermediate small region are weighted and averaged so as to be used as pixel values of a third intermediate small region, and the pixel values of one of the first, second and third intermediate small regions are used as pixel values of the intra-frame prediction small region according to the switching signal.

24. The image predictive decoding apparatus as claimed in Claim 20 or 22,

wherein an apparatus as claimed in Claim 20 or 22,

wherein an average value is determined by using only significant pixel values shown by the reproduction shape signal so as to be used as pixel values of the intra-frame prediction small region.

Detailed Description of the Invention:

[0001]

Field of the Invention:

The present invention relates to compression coding and decoding method and apparatus for storing or transmitting digital image data, and more particularly, the invention relates to method and apparatus for prediction within an image.

[0002]

Prior Art:

For the purpose of efficiently storing or transmitting a digital image, the image is required to be coded in a compression coding manner. As a method for coding a digital image in a compression coding manner, there is a waveform coding method of sub-band coding, wavelet coding, fractal coding or the like other than discrete cosine transform (DCT) represented by the JPEG and the MPEG. For the purpose of removing a redundant signal between images, an inter-image prediction with a motion

compensation is executed, thereby subjecting a differential signal to waveform coding.

[0003]

According to the MPEG system, an input image is processed while being divided into a plurality of 16 × 16 macro blocks. One macro block is further divided into 8 × 8 blocks and quantized after undergoing 8 × 8 DCT transform. This is called an intra-frame coding.

[0004]

On the other hand, according to a motion detection method inclusive of block matching, a prediction macro block having the minimum error with respect to the target macro block is detected from other frames adjacent in time, the detected prediction macro block is subtracted from the target macro block thereby forming a differential macro block, and this macro block is quantized after undergoing 8 × 8 DCT transform. This is called an inter-frame coding, and the prediction macro block is called a prediction signal of the time region. According to the MPEG described above, no image is predicted from an identical frame.

[0005]

A normal image has spatially similar regions, and an image can be approximated to a spatial region by utilizing this characteristic. In a manner similar to that

of the prediction signal of the time region, a prediction signal can also be obtained from an identical frame. This is called a prediction signal of the spatial region.

[0006]

Problems to be Solved by the Invention:

Since spatially adjacent two pixel values are close to each other, the prediction signal of the spatial region is generally located close to the target signal. On the other hand, on the receiving side or the reproducing side, a signal which has been coded and reproduced in the past is required to be used for the prediction signal since the original image is absent. From these two factors, the prediction signal of the spatial region is required to be generated at high speed. This is because the signal is used for the generation of a prediction signal immediately after the pixel value is decoded and reproduced.

[0007]

Therefore, the prediction signal of the spatial region is required to be generated simply with high accuracy. Furthermore, a speedily operable construction is required in coding and decoding apparatus.

[0008]

The present invention has an object of generating a spatial prediction signal with simplicity, high speed and high precision, and provides coding and decoding apparatus

having a speedily operable construction.

[0009]

Means for Solving the Problems:

To achieve this object, according to the present invention, there is provided an image predictive coding apparatus characterized in that,

in a process of dividing an image to be coded into a plurality of adjacent small regions and coding a target small region among the plurality of adjacent small regions,

said apparatus performs the following steps of: using reproduced pixel values adjacent to the target small region as pixel values of an intra-frame prediction small region of the target small region; using the intra-frame prediction small region as an optimum prediction small region; generating a difference small region from the target small region and the optimum prediction small region; coding the difference small region; after these steps, decoding the coded difference small region, adding the decoded difference small region to the optimum prediction small region, and generating and storing a reproduced small region.

[0010]

Further, said image predictive coding apparatus further performs a step of generating a time prediction

small region from at least one reference image which has been coded and reproduced previously in time in addition to the intra-frame prediction small region,

wherein pixel value of one of the intra-frame prediction small region and the time prediction small region are used as the pixel value of the optimum prediction small region.

[0011]

Also, according to the present invention, there is provided an image predictive decoding apparatus comprising:

an input terminal, a data analyzer, a decoder, an adder, a prediction signal generator and a line memory,

wherein said image predictive coding apparatus performs the following steps of: receiving an input of a coded image data series through the input terminal; analyzing the coded image data series and outputting an image difference signal by the data analyzer; inputting the difference image signal to the decoder and restoring it to a reproduction difference small region; inputting pixel values to the prediction signal generator from the line memory, using reproduced pixel values adjacent to the reproduction difference small region as pixel values of an intra-frame prediction small region, and outputting the intra-frame prediction small region as an optimum

prediction small region; and adding the reproduction difference small region to the optimum prediction small region by the adder, outputting an image and storing only pixel values for generating the intra-frame prediction small region into the line memory.

[0012]

Embodiments of the Invention:

Embodiments of the present invention will be described below with reference to Figs. 1 to 10.

[0013]

(Embodiment 1)

Fig. 1 shows a block diagram of an image predictive coding apparatus according to the Embodiment 1 of the present invention. In Fig. 1 are shown an input terminal 101, a first adder 102, an encoder 103, an output terminal 106, a decoder 107, a second adder 110, a line memory 111 and a prediction signal generator 112.

[0014]

With regard to the image predictive coding apparatus constructed as shown above, its operation is described below. A target image to be subjected to a coding process is inputted to the input terminal 101. The inputted image is divided into a plurality of adjacent small regions. Fig. 2 shows the input image in a case where it is divided into 8 × 8 small regions. Fig. 3 shows

the inputted image in a case where it is divided into triangular small regions. The plurality of small regions are successively coded, where a target small region is inputted to the first adder 102 via a line 113. The prediction signal generator 112 generates an intra-frame prediction small region and inputs the resulting intra-frame prediction small region as an optimum prediction small region to the first adder 102 via a line 121.

[0015]

The first adder 102 subtracts the corresponding pixel value of the optimum prediction small region from the pixel value of the target small region, thereby generating a difference small region and inputting the difference small region to the encoder 103 for the execution of a compression coding process. In the present embodiment, the difference small region is transformed into an image signal of a frequency region by the DCT transformer (104). Then, DCT transform coefficients are quantized by a quantizing unit Q (105). The quantized small region is outputted to the output terminal 106, further transformed into a code of a variable length or a fixed length and thereafter stored or transmitted (not shown).

[0016]

At the same time, the quantized small region is outputted to the decoder 107, where it is restored to an

expanded difference small region. In the present embodiment, the small region is inverse quantized by the inverse quantizing unit 108, and thereafter transformed into a signal of a spatial region by an inverse discrete cosine transformer IDCT (109). The thus-obtained expanded difference small region is outputted to the second adder 110, and the second adder 110 adds an optimum prediction image signal outputted via the lines 121 and 122 to thereby generate a reproduction small region and stores a reproduction pixel value for generating an intra-frame prediction image signal from the reproduction small region reproduction small region into the line memory 111. The prediction signal generator 112 generates the intra-frame prediction small region as follows.

[0017]

That is, the prediction signal generator 112 generates a pixel value of the reproduced small region adjacent to the target small region as a pixel value of the intra-frame prediction small region. In Fig. 2, assuming that a block 200 is the target small region, then the pixel values of the adjacent reproduced small region are a0, a1, a2, ..., a6, a7, b0, b1, b2, ..., b6, b7. In Fig. 3, assuming that a triangle 301 is the target small region, then the pixel values of the adjacent reproduced small region are g0, g1, ..., g4, f0, f1, f2, ..., f7, f8.

[0018]

Assuming that a triangle 300 is the target small region, the pixel values of the adjacent small region are e0, h0, h1, ..., h4. These pixel values are stored into the line memory 111. The prediction signal generator 112 makes access to the line memory 111 to read out the adjacent pixel values as the pixel values of the intra-frame prediction small region.

[0019]

Fig. 4A and Fig. 4B show block diagrams of an embodiment in which an intra-frame prediction small region of a block 200 of Fig. 2 is generated. In Fig. 4A, the pixel values a0, a1, a2, ..., a6, a7 which are vertically adjacent to one another are inputted, and a generator 401 generates an intra-frame prediction small region 403 by repetitively outputting an identical pixel in the horizontal direction. The intra-frame prediction small region 403 is used in a case where no horizontally adjacent pixel exists. In Fig. 4B, the pixel values b0, b1, b2, ..., b6, b7 which are horizontally adjacent to one another are inputted, and a generator 402 generates an intra-frame prediction small region 404 by repetitively outputting a pixel in the vertical direction.

[0020]

The intra-frame prediction small region 404 is

used in a case where no horizontally adjacent pixel exists. In a case where pixels which are adjacent in both the horizontal direction and the vertical direction exist, an intra-frame prediction small region is generated as in an embodiment shown in Fig. 5.

[0021]

That is, an adder 500 averages the intra-frame prediction small region 403 and the intra-frame prediction small region 404. Thus, the adjacent reproduced pixels are repetitively outputted and the averaging computation is merely executed, and therefore, the intra-frame prediction small region can be generated at high speed. It is acceptable to generate the intra-frame prediction small region by linearly interpolating adjacent pixel values.

[0022]

Fig. 6 shows a block diagram of a third embodiment of the prediction signal generator 112. The pixel values a0, a1, a2, ..., a6, a7 which are vertically adjacent to one another are inputted, and the generator 401 generates a first intra-frame prediction small region by repetitively outputting each pixel in the horizontal direction. The pixel values b0, b1, b2, ..., b6, b7 which are horizontally adjacent to one another are inputted, and the generator 402 generates a second intra-frame prediction small region by repetitively outputting each pixel in the

vertical direction. The first intra-frame prediction small region and the second intra-frame prediction small region are inputted to the adder 500, and a third intra-frame prediction small region is generated by averaging these two small regions.

[0023]

On the other hand, the target small region is inputted via a line 616. The first intra-frame prediction small region and the target small region are inputted to an error calculator 601, and the error calculator 601 calculates a first absolute error. The second intra-frame prediction small region and the target small region are inputted to an error calculator 602, and the error calculator 602 calculates a second absolute error. The third intra-frame prediction small region and the image data of the target small region are inputted to an error calculator 603, and the error calculator 603 calculates a third absolute error. The first, second and third absolute errors are inputted to a comparator 604. The comparator 604 determines the one having the smallest absolute error and controls a switch 605 so as to output the intra-frame prediction small region corresponding to it to the line 121.

[0024]

The comparator 604 simultaneously outputs an

identifier for identifying the first, second and third intra-frame prediction small regions via a line 615. With this identifier, the intra-frame prediction small region is uniquely determined on the receiving side. Thus by using the intra-frame prediction small region having the smallest error, a differential signal can be suppressed, thereby allowing the reduction in the number of bits to be generated.

[0025]

(Embodiment 2)

Fig. 7 shows a block diagram of an image predictive coding apparatus according to the Embodiment 2 of the present invention. In this image predictive coding apparatus, a motion detector 700, a motion compensator 701, an optimum mode selector 703 and a frame memory 702 are added to the construction of Fig. 1.

[0026]

With regard to the image predictive coding apparatus as described above, its operation will be described below. In a manner Similar to that of the Embodiment 1, the target small region of an input image is inputted. The adder 102 subtracts the target small region from an optimum prediction small region inputted via a line 121. The encoder 103 outputs the subtraction result to an output terminal 106 while encoding the data in a

compression coding manner. At the same time, the decoder 107 expands the compressed small region, and thereafter the optimum prediction small region is added.

[0027]

Then, in a manner similar to that of the Embodiment 1, only the pixel value to be used for generating an intra-frame prediction small region is stored into a line memory 111, while all the pixel values of the reproduced image are stored into the frame memory 702.

[0028]

When the next image is inputted, the motion detector 700 receives the inputs of the target small region and the reproduction image stored in the frame memory 702, and the motion detector 700 detects the motion of the image by block matching or similar method and outputs a motion vector to a line 705. The outputted motion vector is subjected to variable length coding, and transmitted (not shown) and simultaneously transmitted to the motion compensator 701. The motion compensator 701 generates a time prediction small region from the reproduction image of the frame memory 702 on the basis of the motion vector and input the same to the optimum mode selector 703. The motion detecting process and the motion compensating process include forward prediction, backward prediction and bidirectional prediction, and these methods are disclosed

in, for example, U.S.P. No. 5,193,004.

[0029]

On the other hand, in a manner similar to that of the Embodiment 1, the prediction signal generator 112 generates the intra-frame prediction small region, and inputs the intra-frame prediction small region to the optimum mode selector 703 and simultaneously inputs the target small region to the optimum mode selector 703. The optimum mode selector 703 selects the image data having the smallest error (e.g., the sum of the absolute values of differences obtained every pixel) with respect to the target small region from the intra-frame prediction small region and a time prediction small region and outputs the selected image data as an optimum prediction small region to the adder 102. An identifier representing the prediction small region which has been selected is outputted to be transmitted via a line 709.

[0030]

As described above, there is no need for transmitting any inter-frame motion vector by introducing the intra-frame prediction to the image data coded with inter-frame motion compensation, and therefore, the number of bits can be further reduced.

[0031]

The Embodiments 1 and 2 are in the case where

significant pixels exist throughout the entire screen. There is a case where a significant pixel and an insignificant pixel exist in a screen. For example, in the case of an image picked up by chromakey, pixels expressing the subject are significant, and pixels expressing a region in blue or the like which serves as a background are insignificant pixels. By transmitting the texture and shape of the significant object through coding, reproduction and display of each object can be achieved. When generating the intra-frame prediction small region by the prediction signal generator 112 for such an input image, insignificant pixel values cannot be used.

[0032]

Fig. 8 shows a schematic view of input images having significant pixels and insignificant pixels. A shape signal is used for expressing whether or not the pixel is significant. The shape signal is compression-coded by a specified method and transmitted. As a method for coding a shape, a chain coding method and the like are available. A compressed shape signal is reproduced by being expanded again, and the reproduced shape signal is used for generating an intra-frame prediction image signal as follows.

[0033]

In Fig. 8A, a shape curve 800 is the boundary

line and the direction indicated by arrow is the inside of an object, which is comprised of significant pixels. Among the reproduced pixels adjacent to a target small region 802, b4, b5, b6 and b7 are the significant pixels, and only these pixel values are repetitively used as the pixel values of the intra-frame prediction small region of the target small region 802. In Fig. 8B, a shape curve 804 is the boundary line, and the direction indicated by arrow is the inside of an object, which is comprised of significant pixels. Among the reproduced pixels adjacent to a target small region 805, a4, a5, a6 and a7 are the significant pixels, and only these pixel values are repetitively used as the pixel values of the intra-frame prediction small region of the target small region 805.

[0034]

Further, in Fig. 8C, a curve 808 is the boundary line, and the direction indicated by arrow is the inside of an object, which is comprised of significant pixels. Among the reproduced pixels adjacent to a target small region 810, a5, a6, a7, b4, b5, b6 and b7 are the significant pixels, and only these pixel values are repetitively outputted. In a place where two pixel values overlap each other, a value obtained by averaging those pixel values is used as the pixel value of the intra-frame prediction small region of the target small region 810.

[0035]

For example, the value of a pixel z_77 of the target small region 810 is the average value of a7 and b7. In a place where no pixel exists, the average value of horizontally and vertically adjacent two pixel values is taken. For example, the value of a pixel z_14 is the average value of a5 and b3. Thus, the intra-frame prediction small region of an image having an arbitrary shape is generated. Although the aforementioned embodiment has been described on the basis of a small region divided in a square shape, the screen may be divided into triangular small regions as in Fig. 3.

[0036]

As another embodiment, it is acceptable to determine the average value by using only the significant pixel values and use the average value as the pixel value of the intra-frame prediction small region. In Fig. 8A, the average value of the pixels b4, b5, b6 and b7 is calculated, and the calculated average value is used as the pixel value of the intra-frame prediction small region. In Fig. 8B, the average value of the pixels a4, a5, a6 and a7 is calculated, and the calculated average value is used as the pixel value of the intra-frame prediction small region. In Fig. 8C, the average value of the pixels a5, a6, a7, b4, b5, b6 and b7 is calculated, and it is used as the pixel

value of the intra-frame prediction small region.

[0037]

(Embodiment 3)

Fig. 9 is a block diagram showing an image predictive decoding apparatus according to the Embodiment 3 of the present invention. In Fig. 9 are shown an input terminal 901, a data analyzer 902, a decoder 903, an adder 906, an output terminal 907, a controller 908, a motion compensator 909, a prediction signal generator 910, a line memory 911 and a frame memory 912.

[0038]

With regard to the image predictive decoding apparatus constructed as shown above, its operation is described below. Compression-coded image data is inputted to the data analyzer 902. The data analyzer 902 analyzes the inputted image data, outputs data of a compressed difference small region to the decoder 903 via a line 915, outputs a control signal to the controller 908 via a line 926 and further outputs the motion vector (only when it exists) to the motion compensator 909. The decoder 903 expands the difference small region to restore the data into an expanded difference small region.

[0039]

In the present embodiment, the compressed image data of the difference small region is inverse quantized by

the inverse quantizing unit Q (904), and the signal of a frequency region is transformed into a signal of a spatial region by the inverse IDCT (905). The expanded difference small region is inputted to the adder 906, and the adder 906 adds an optimum prediction small region transmitted via a line 924, thereby generating a reproduction small region. The adder 906 outputs the reproduced image to the output terminal 907 and simultaneously stores the image into the frame memory 912. The pixel values for use in generating an intra-frame prediction small region are stored into the line memory 911.

[0040]

The optimum prediction small region is determined by the controller 908 on the basis of a control signal. In a case where the intra-frame prediction small region is selected, the switch 913 is connected to the line 922, so that the prediction signal generator 910 makes access to the line memory 911 to output the adjacent reproduction pixel value as the pixel value in the intra-frame prediction small region. The details have already been described with reference to Fig. 4A, Fig. 4B and Fig. 5. In a case where a time prediction small region is selected, the switch 913 is connected to the line 923, so that the motion compensator 909 generates the time prediction small region from the frame memory 912, and outputs it, on the

basis of a motion vector transmitted via a line 925.

[0041]

(Embodiment 4)

Fig. 10 is a block diagram showing an image predictive decoding apparatus according to the Embodiment 4 of the present invention. A shape decoder 1000 is added to the basic construction of Fig. 9. The basic operation of the image predictive decoding apparatus is the same as that of Fig. 9, and therefore, only the different operation will be described below.

[0042]

In the present embodiment, the compression-coded image data includes compression-coded shape data. The data analyzer 902 extracts the shape data and outputs the same to the shape decoder 1000, where the shape decoder 1000 reproduces a shape signal in an expanding manner. The reproduced shape signal, upon being outputted, is inputted to the prediction signal generator 910. The prediction signal generator 910 generates an intra-frame prediction small region as described with reference to Fig. 8 based on this reproduced shape signal. Thus, the intra-frame prediction small region of the image having an arbitrary shape is generated, and the image can be decoded and reproduced.

[0043]

The Embodiments 3 and 4 are characterized by the line memory 911. In the absence of the line memory 911, access must be made from the frame memory 912 to a pixel for generating the intra-frame prediction small region. For the purpose of generating a prediction signal by pixels of the adjacent small region, it is required to execute write and read out the same at high speed on the frame memory. By providing a special line memory or buffer, the intra-frame prediction small region can be generated at high speed without using any high-speed frame memory.

[0044]

Effects of the Invention:

As described above, according to the present invention, by merely using the reproduced pixel values adjacent to the target small region as the pixel values of the intra-frame prediction signal, a high-accuracy prediction signal can be simply generated with a smaller amount of computation, and this can produce an effect that the number of bits of the intra-frame coding can be reduced. The line memory is provided for storing therein the reproduced pixel values for use in generating the intra-frame prediction signal, and therefore, access can be made at high speed to the pixel values, thereby allowing the intra-frame prediction signal to be generated at high speed.

Brief Description of the Drawings:

Fig. 1 is a block diagram showing an image predictive coding apparatus according to the Embodiment 1 of the present invention;

Fig. 2 is a schematic view in a case where an input image for use in the image predictive coding apparatus according to an embodiment of the present invention is divided into 8 × 8 blocks;

Fig. 3 is a schematic view in a case where an input image for use in the image predictive coding apparatus according to an embodiment of the present invention is divided into triangular regions;

Fig. 4 is a block diagram showing a first embodiment of a prediction signal generator for use in the image predictive coding apparatus according to an embodiment of the present invention;

Fig. 5 is a block diagram showing a second embodiment of a prediction signal generator for use in the image predictive coding apparatus according to an embodiment of the present invention;

Fig. 6 is a block diagram showing a third embodiment of a prediction signal generator for use in the image predictive coding apparatus according to an embodiment of the present invention;

Fig. 7 is a block diagram showing an image

predictive coding apparatus according to the Embodiment 2 of the present invention;

Fig. 8 is a schematic view showing an input image which is inputted to the image predictive coding apparatuses according to an embodiment of the present invention and includes significant and insignificant pixels;

Fig. 9 is a block diagram showing an image predictive decoding apparatus according to the Embodiment 3 of the present invention; and

Fig. 10 is a block diagram showing an image predictive decoding apparatus according to the Embodiment 4 of the present invention.

Reference numerals:

101 input terminal
102 first adder
103 encoder
104 DCT transformer
105 quantizing unit
106 output terminal
107 local decoder
108 inverse quantizing unit
109 inverse DCT transformer
110 second adder
111 line memory

112 prediction signal generator

Document Name: Drawings

Fig. 1

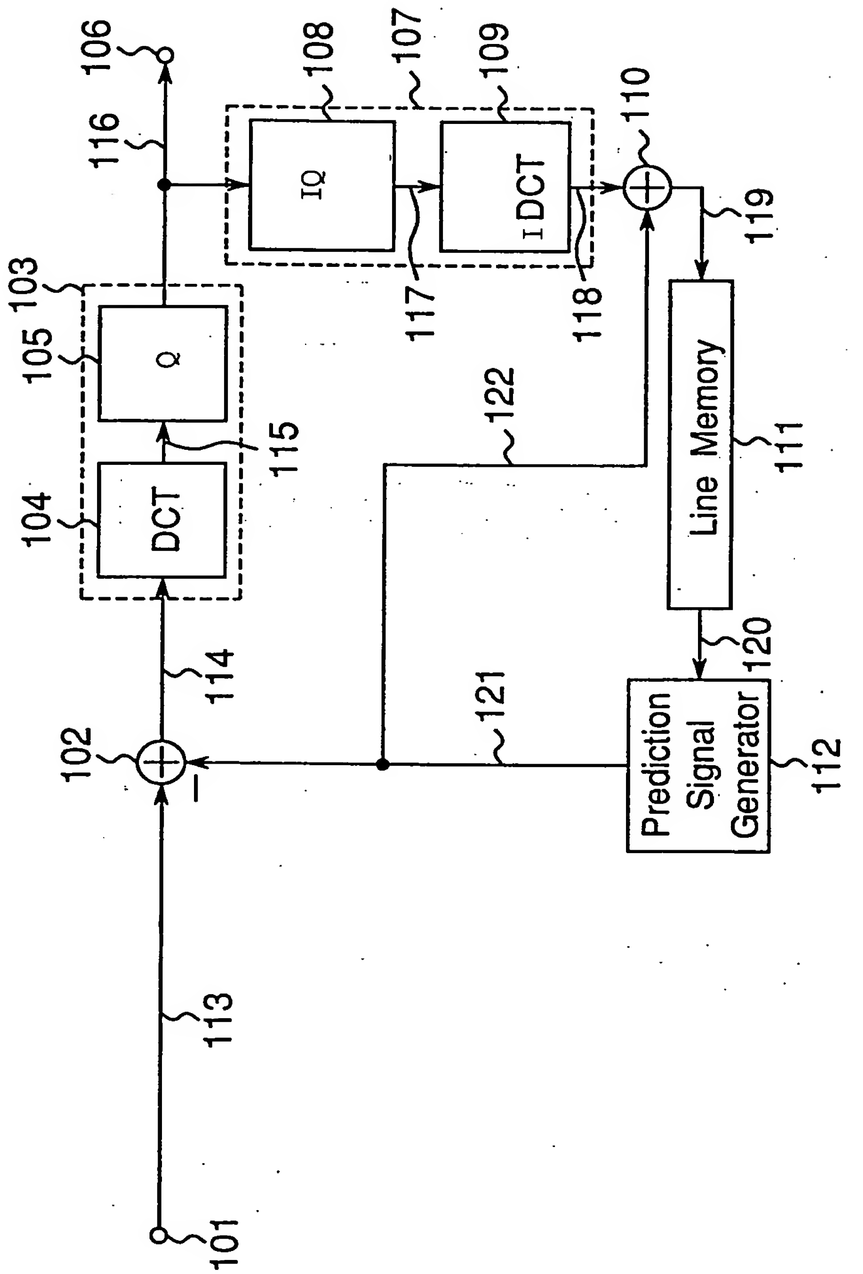


Fig.2

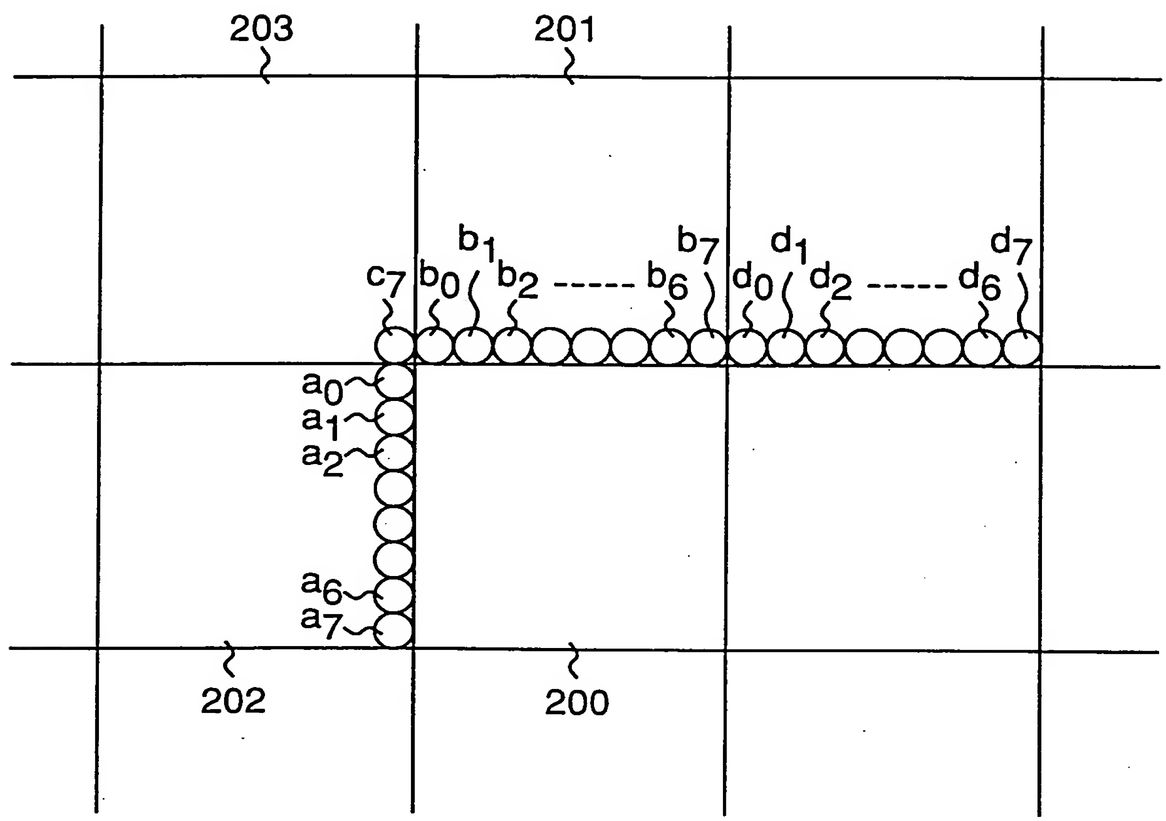


Fig.3

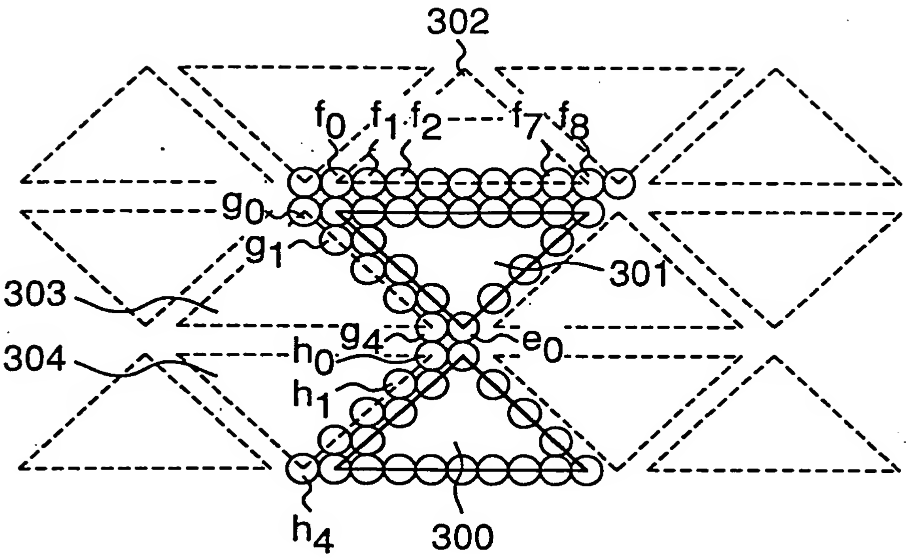


Fig. 4

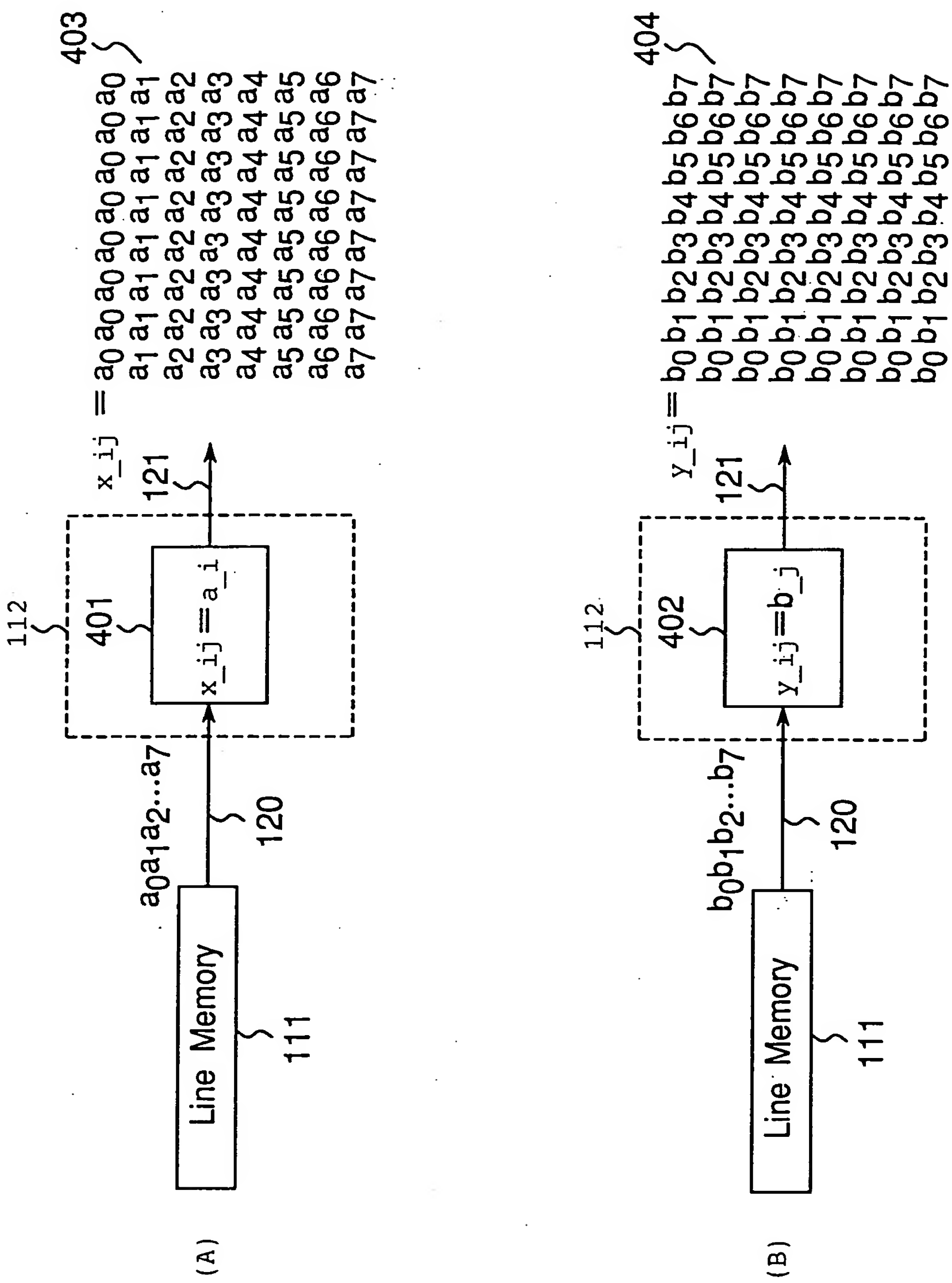
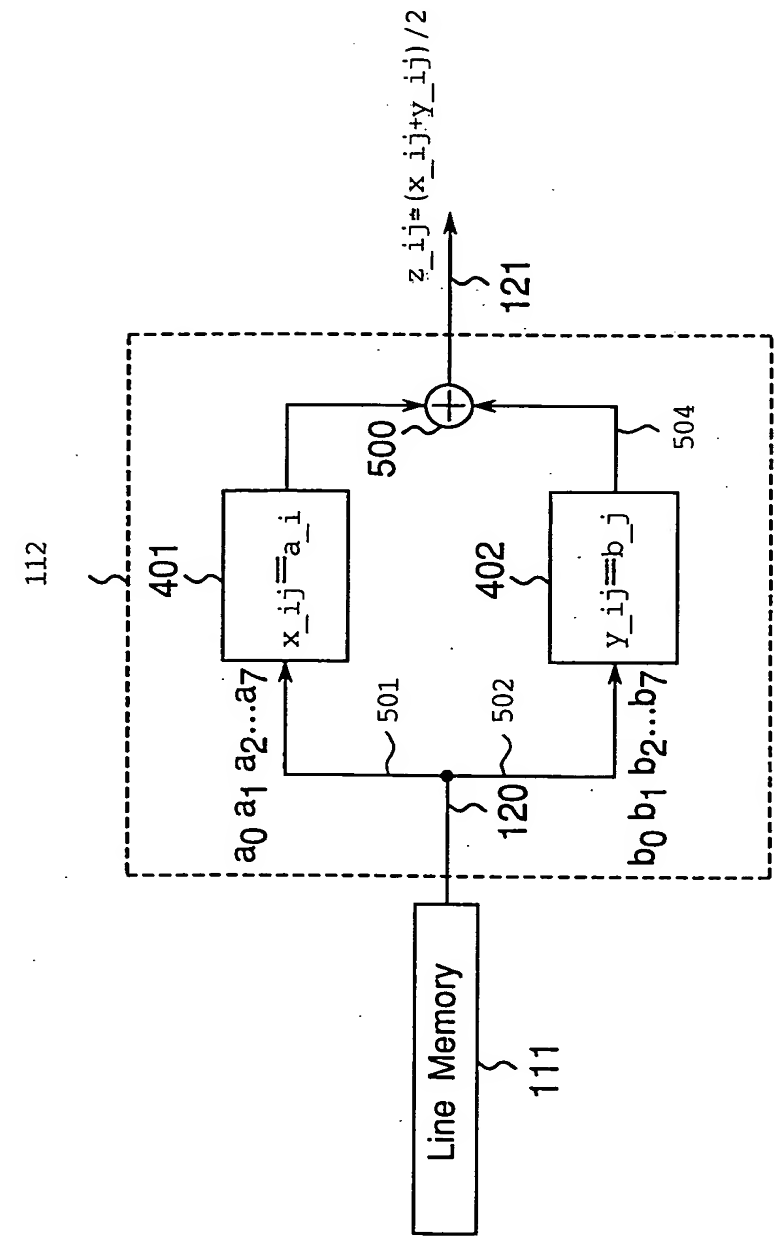
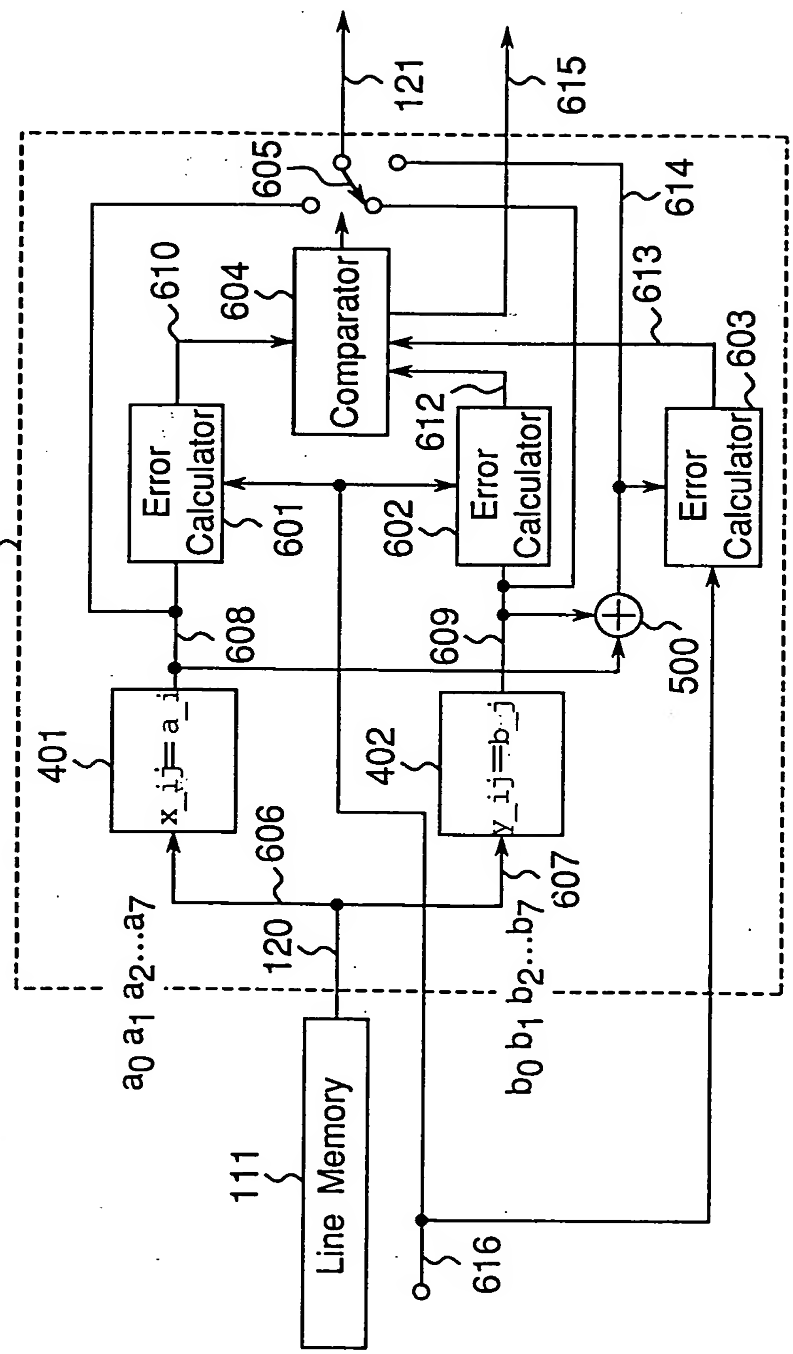

(A)
Line Memory
111
a0a1a2...a7
120
112
401
x_ij=a_i
121
x_ij
403
(B)
Line Memory
111
b0b1b2...b7
120
112
402
y_ij=b_j
121
y_ij
404

Fig. 5



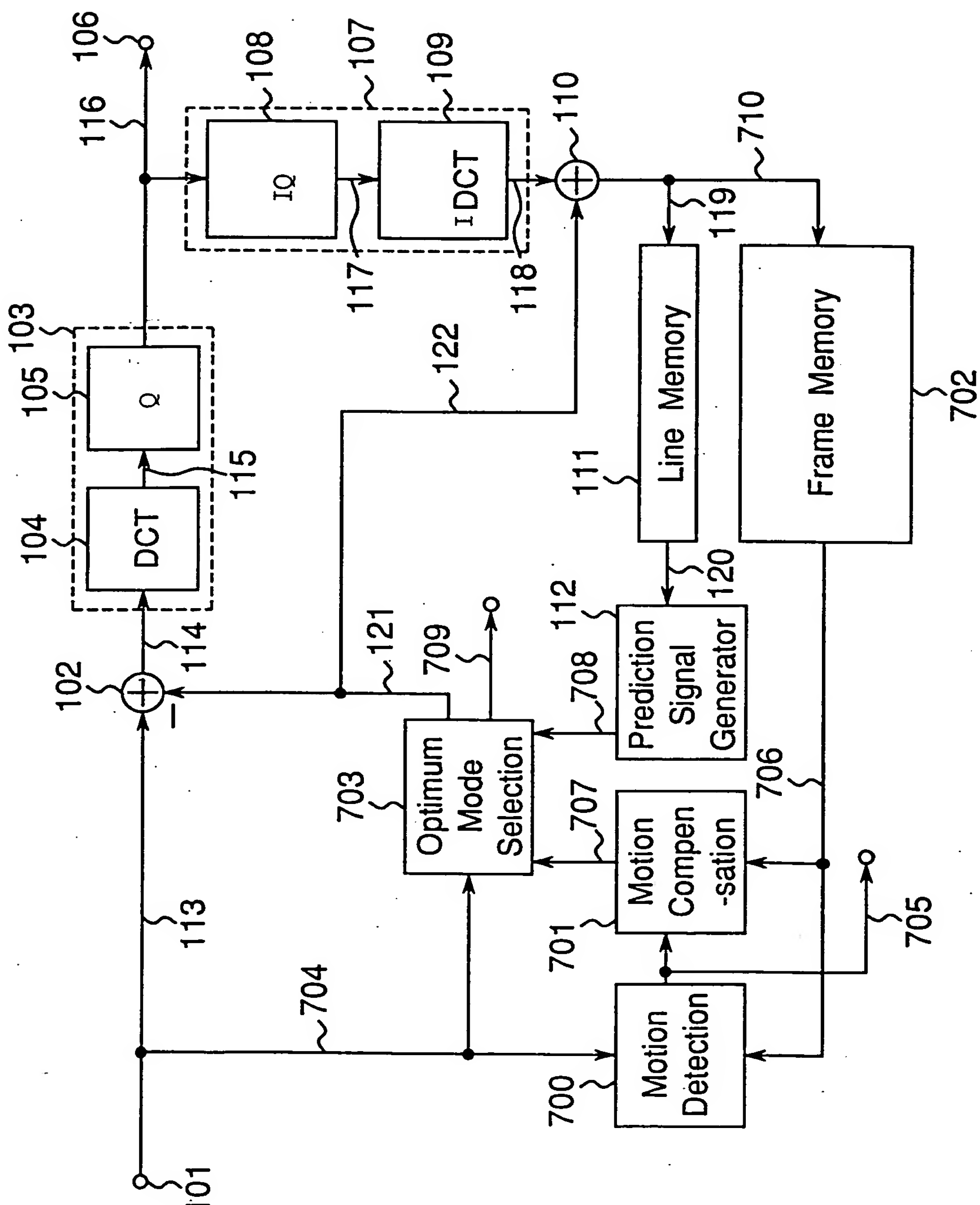
z_ij=(x_ij+y_ij)/2
121
112
401
x_ij=a_i
500
504
402
y_ij=b_j
a0 a1 a2...a7
501
502
120
b0 b1 b2...b7
Line Memory
111

Fig. 6



112
Line Memory
111
a_0 a_1 a_2...a_7
b_0 b_1 b_2...b_7
120
606
607
401
x_ij=a_i
402
y_ij=b_j
608
609
500
Error Calculator
601
Error Calculator
602
Error Calculator
603
Comparator
604
610
612
613
614
605
121
615
616

Fig. 7



DCT
Q
IQ
IDCT
Line Memory
Frame Memory
Prediction Signal Generator
Motion Compensation
Motion Detection
Optimum Mode Selection
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
700
701
702
703
704
705
706
707
708
709
710

Fig. 8

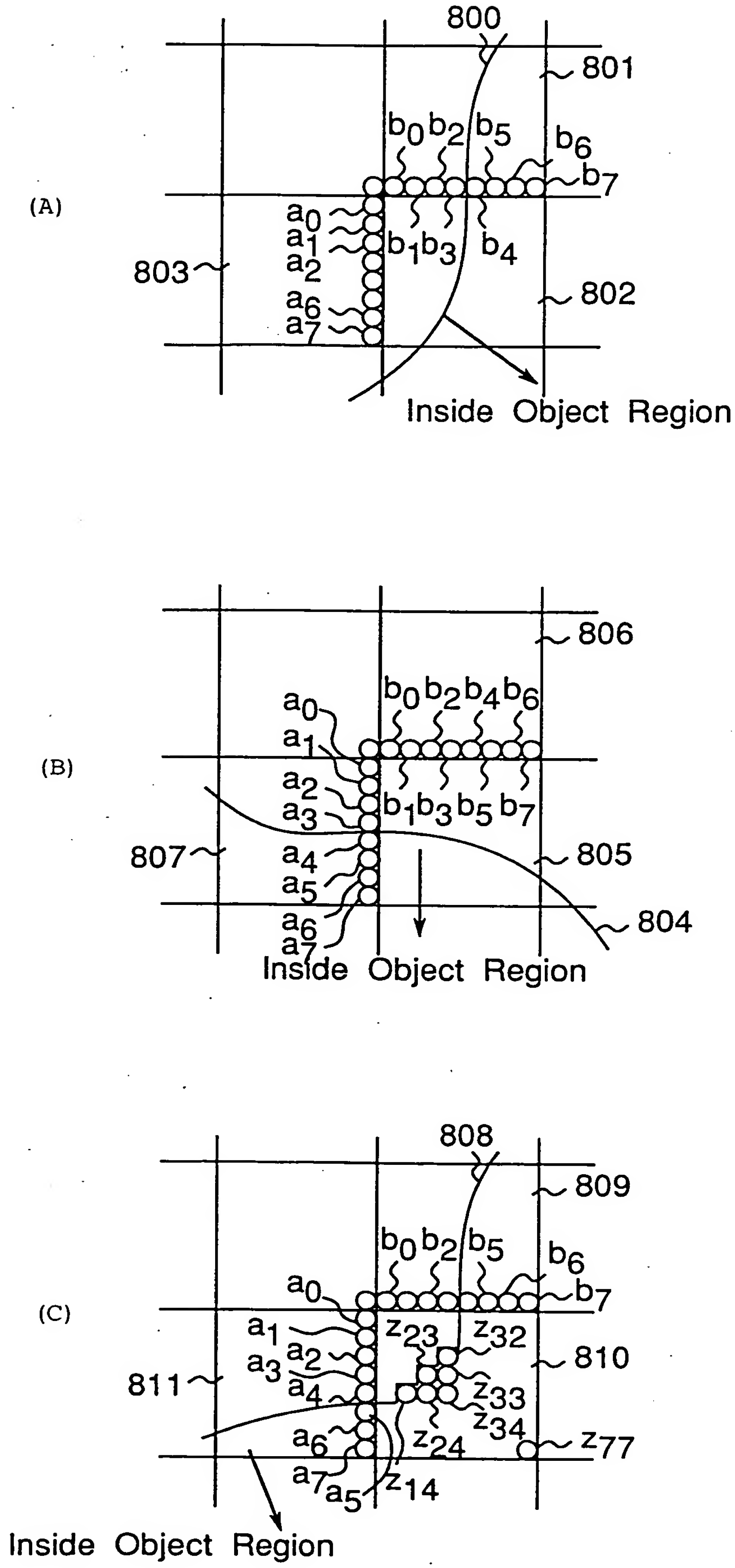
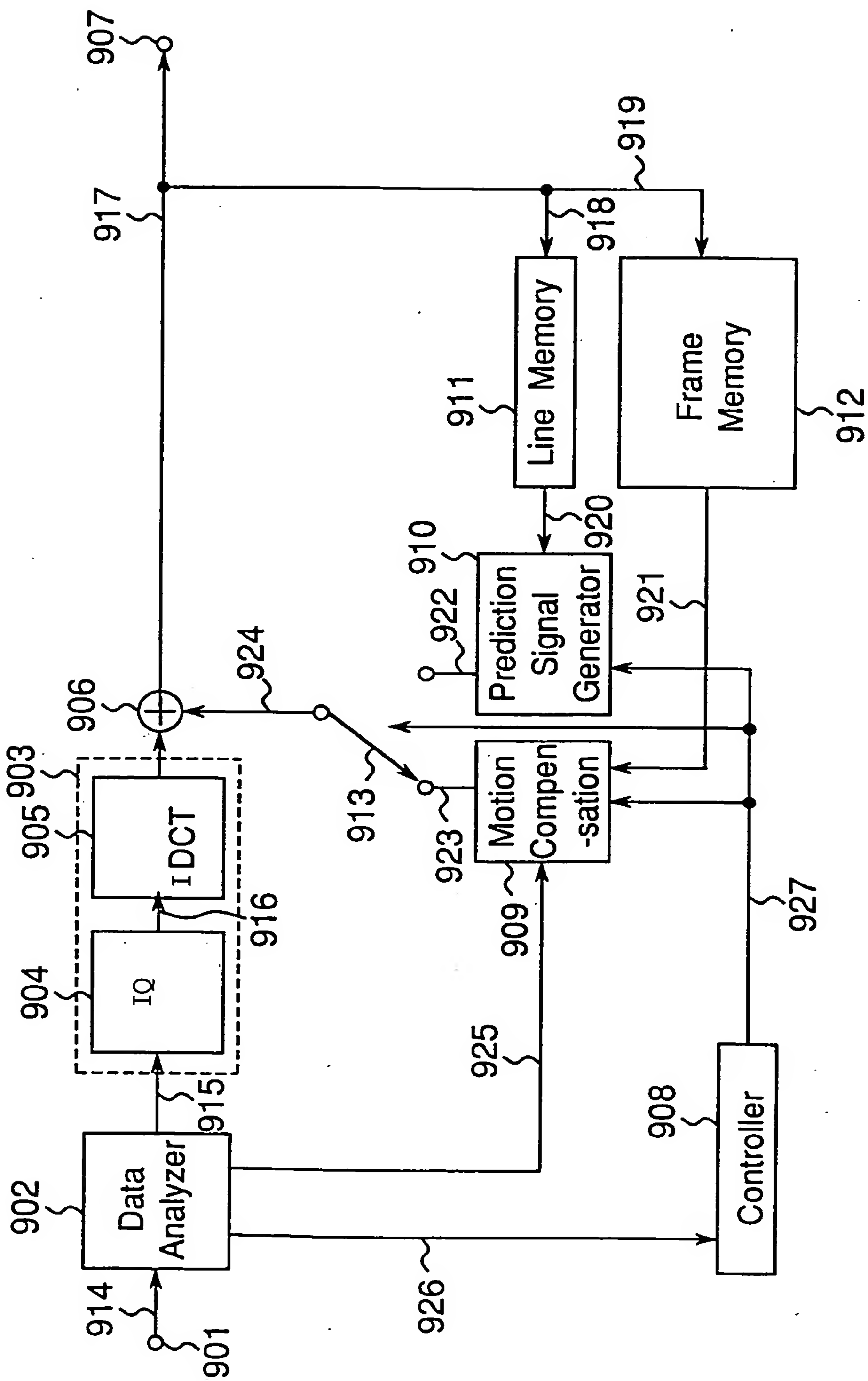

(A)
800
801
802
803
b_0 b_1 b_2 b_3 b_4 b_5 b_6 b_7
a_0 a_1 a_2 a_6 a_7
Inside Object Region
(B)
804
805
806
807
a_0 a_1 a_2 a_3 a_4 a_5 a_6 a_7
b_0 b_1 b_2 b_3 b_4 b_5 b_6 b_7
Inside Object Region
(C)
808
809
810
811
a_0 a_1 a_2 a_3 a_4 a_5 a_6 a_7
b_0 b_2 b_5 b_6 b_7
z_{23} z_{32} z_{33} z_{34} z_{24} z_{14} z_{77}
Inside Object Region

Fig. 9



Data Analyzer
IQ
IDCT
Line Memory
Frame Memory
Prediction Signal Generator
Motion Compen -sation
Controller
901
902
903
904
905
906
907
908
909
910
911
912
913
914
915
916
917
918
919
920
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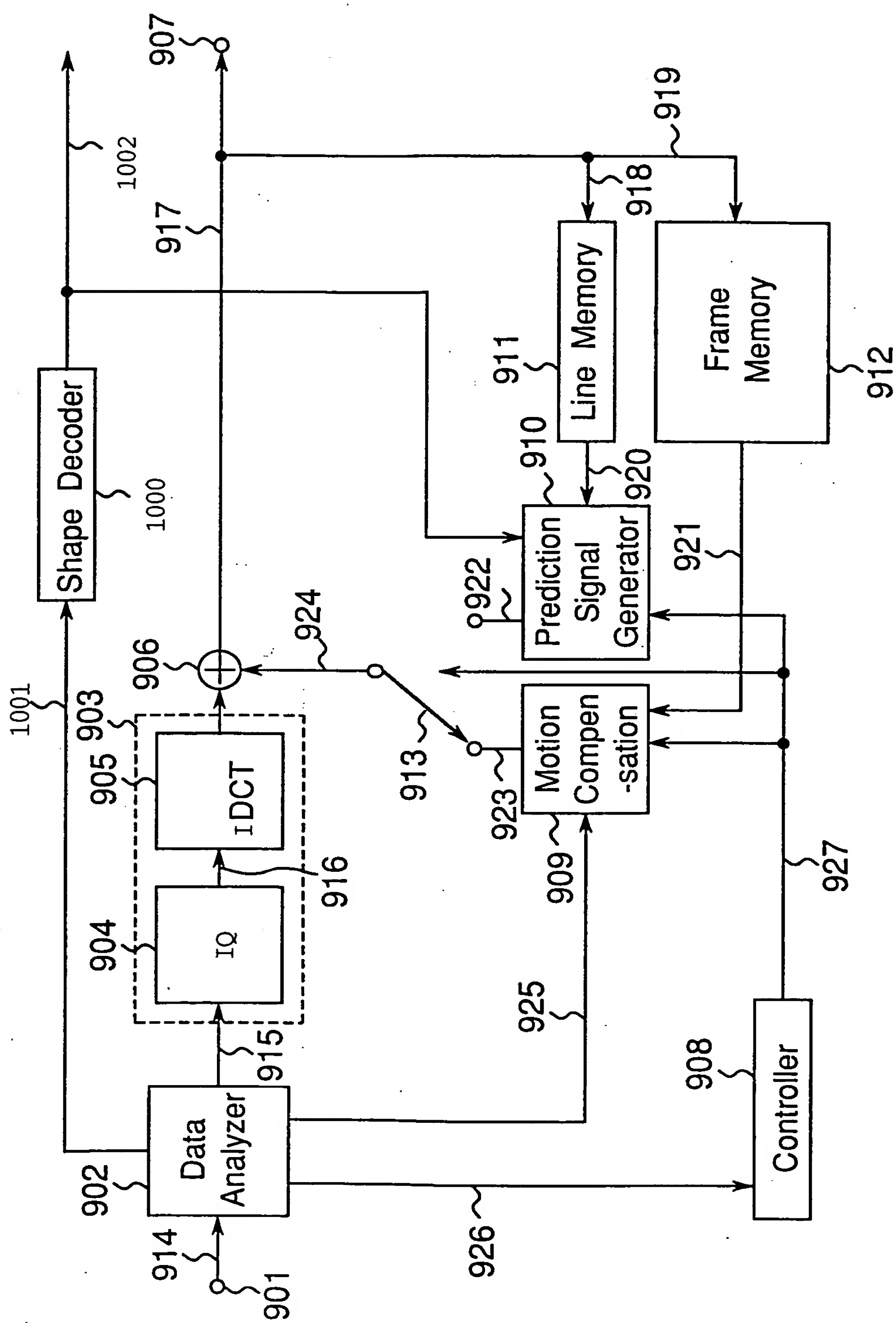
922
923
924
925
926
927

Fig. 10



Shape Decoder
Data Analyzer
IQ
IDCT
Motion Compen -sation
Prediction Signal Generator
Line Memory
Frame Memory
Controller
901
902
903
904
905
906
907
908
909
910
911
912
913
914
915
916
917
918
919
920
921
922
923
924
925
926
927
1000
1001
1002

Document Name: Abstract

Abstract:

(Object) It is necessary to generate a prediction signal of a spatial region simply with high precision. Coding and decoding apparatus are required to be capable of high-speed operation.

(Solution) In a process of dividing the image to be coded into a plurality of adjacent small regions and coding a target small region among the plurality of adjacent small regions, the apparatus uses reproduced pixel values adjacent to the target small region as pixel values of an intra-frame prediction small region of the target small region, uses the intra-frame prediction small region as an optimum prediction small region, generates a difference small region from the target small region as well, encodes the difference small region, after these steps, decodes the coded difference small region, adds the decoded difference small region to the optimum prediction small region, and generates and stores a reproduced small region.

Selected Figure: Fig. 1

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Corrected Document: Petition for Patent

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